Managerial Demographics: Measurement and Implications for the Innovation Performance of Manufacturing Firms

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ABSTRACT

The present study addresses the perceived gap in literature on contribution of managerial demographics to the innovation performance of manufacturing firms of 12 European countries so as to highlight the distinctive role of managers in a broader context. The managerial demographics is conceptualised as the managerial knowledge(education and experience), gender role (number of female managers), leadership role (top manager's years of experience) and, management ratio. The effect of managerial demographics is examined on two dimensions of innovation performance: first, the propensity of firms to perform innovation and, second, the innovation intensity of firms. We report that the role of female managers in innovation is more significant, than that otherwise emphasised in innovation literature, as evident in case of countries under study. And, the number of female managers have a positive impact on the innovation performance of manufacturing firms. Moreover, the results show that managerial experience also have a non-linear effect on the innovation performance of manufacturing firms. Finally, the implications of the findings are discussed in-detail.

Keywords: Managerial Demographics, Management Ratio, Managerial Knowledge, Gender-role, Leadership-Role, Innovation Intensity.

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I. INTRODUCTION

It is common to highlight the role of technological innovations in the success of firms. There exists extant literature that covers the impact of numerous internal factors such as size (Cohen and Klepper 1996, Baldwin and Sabourin 1999), age (Sorensen and Stuart, 2000), ownership (Zakić et al, 2008), R&D performance (Von Hippel, E., 1988, Baldwin and Sabourin 1999) and various strategic orientations of firms (Narver and Slater, 1990; Gatignon and Xuereb, 1997; Kahn, 2001; Li, Liu and Zhao, 2006) and external factors such as sector, competitive intensity (Bonanno, et al., 2008), technological opportunities (Zakić et al, 2008) and demand (Baldwin and Sabourin 1999, Guerzoni 2007, Zakić et al, 2008) on the innovation performance of firms.

However, there are studies that highlight the neglect of managerial role in innovation. Bosch and Wijk (2001, pg. 159) critique the resource-based view of the firm saying that it "largely neglects to address thoroughly the role of managers in the competitive equation". Teece (2007) underscore that executives recognize new challenges in competitive environments and understand how technological innovation is necessary but not sufficient for success. Volberda and Bosch (2005) underlines the strong bias towards technological innovation and negligence of administrative innovation in a national level study and, indicate that the study has failed to report "non-technological capacities of innovation organization". The prior statements indicate to the organizational and managerial capabilities other than the technological competence that enhance the innovation performance of firms. In the same vein, Bosch and Wijk (2001, Pg 169) highlight studies that emphasize that the field of strategic management has failed to recognize "...management capability per se as a more specific human asset" than the 'human capital' itself.

In short, whilst the innovation literature is replete with studies of the technological and structural antecedents of innovation, the role of management is less well understood. I aim to address this perceived gap in literature on contribution of managerial capabilities towards the innovation performance of firms as it is a longstanding concern.

Thirty years ago, Utterback (1971; Pg.76) lamented the fact that "while the need for knowledge and understanding of developing technology by managers, executives, and other key individuals is apparent, the body of systematic knowledge in this field is relatively small". Unfortunately, even today, there is limited systematic research that addresses the role of managers and executives in the process of innovation. Citing numerous studies, Volberda and Bosch (2005) underline that "...often neglected determinants of rebuilding competitive advantage by innovation are the managerial and organization capabilities to recognize external knowledge, assimilate it, and apply it to commercial ends". There is a broad consensus among strategy scholars that the need for the new managerial capabilities and organizing principles in hyper competitive environments is even greater than ever (Volberda, 1996). Teece (2007, Pg.1322) emphasizes that "not only must the innovating enterprise spend heavily on R&D and assiduously develop and protect its intellectual property; it must also generate and implement the complementary organizational and managerial innovations needed to achieve and sustain competitiveness". Castanias and Helfat (1991) propose that top management is a resource in terms of managerial skills from which "differential rents may flow", and thus represent a significant source of "sustainable competitive advantage" (cited by Bosch and Wijk, 2001, Pg. 183).

In view of the recognised importance of managerial capabilities for the innovation process and the perceived lack of systematic research on the topic, we endeavour to study the impact of managerial demographics on the innovation performance as measured by two dimensions. Firstly, the 'occurrence of innovation' is measured by observing whether the firms have introduced new products/services in last three years or not. Secondly, we will examine how managerial demographics impact the 'scale of innovation' in firms by taking into account the innovation intensities of firms. It should be noted here that 'innovation intensity' is an output indicator that reflects past innovation efforts of a firm. Output indicators have the advantage over the input indicators as they measure "the success of innovation, that is, indirectly to give more weight to innovation efforts that turn out successful" (Mohnen & Dagenais, 2000; Pg. 18). The present study is extended to the manufacturing sectors of 12 countries covered by the MOI survey 2008-2009[1]. Following is the research question for the study:

- What is the impact of managerial demographics on the innovation performance of firms?

II. LITERATURE REVIEW

THREEFOLD MANAGERIAL ROLE

It is the dynamism of two contextual elements that dictates the rate of innovation in a firm or a sector. The first is "current state of technology" and second is "degree of economic and social use of existing products and processes" (Utterback, 1971). In subsequent section, we will discuss the mediating role of managers in correlation with the dynamism of aforementioned contextual

[1] MOI stands for Management, Organization and Innovation Survey.

elements and innovation. Also, we have underline studies that emphasize the managerial role in 'knowledge sourcing'. Following are the three-fold managerial role:

a. CHANGE IN STATE OF TECHNOLOGY

Managerial capabilities are required in diffusion and adoption of technology. That is, role of management is instrumental in the "change in state of technology". In this regard, evidence is provided by the Expert Panel Report of Canada (2009) that underscores "highly-qualified people" as an innovation input and suggests that significant differences in the number of managerial employees in the United States, relative to Canada, with business degrees (about double) is expected to "translate to a difference between U.S. and Canadian businesses, on average, in the propensity to be aware of, and to adopt leading-edge technology and business practices". Baldwin & Sabourin (1998) and Sharpe (2005) indicated that various surveys have consistently documented "lower adoption rates of advanced technologies by Canadian SMEs as compare with their U.S. counterparts" that may be a consequence of a gap in managerial education levels. Moreover, Henderson and Clark (1990) underline that managerial and organizational innovations are innovations that have greater impact on the relationship between the constituting technologies and knowledge components, than on the technologies themselves (cited by Volberda and Bosch, 2005; pg. 4). However, the managerial capacity is a key factor in successful technological innovation as well as technology adoption.

b. CHANGE IN THE DEGREE OF USE OF PRODUCTS OR PROCESSES

The "change in the degree of use of products or processes" makes room for new needs and wants. Such needs should be recognised or perceived by managers. Herhausen (2011) emphasizes the role of managers in building the proactive orientation of the firms towards the customers. Perceiving and gratifying customer's tacit demands is termed as proactive orientation and, it largely contributes to the 'dynamic capability'[2] of the firm (Cromer 2008, Pg. 3; Teece et al, 1997). So, we can say that managers contribute to the dynamic capabilities of the firms. In the same context, Volberda and Bosch (2005, pg.9) highlight the "managerial requirements of dynamic capabilities" as:

- high level learning
- high absorptive capacity
- broad and deep knowledge base
- broad managerial mindsets and much experimentation

And, Teece et al (1997) underscore that 'dynamic capability' increase the innovative capability of firm. So, it can be argued that managers equipped with above four faculties will augment the innovative capability of the firm. And, innovative capability contribute to higher profitability, greater market value, superior credit ratings, and higher survival probabilities (Volberda, et al., 2010), viz. improved firm performance.

c. EXTERNAL AND INTERNAL KNOWLEDGE SOURCING

[2] Dynamic capability is comprised of routines that help organization in adapting, adjusting or reconfiguring their resources and processes in response to changing customer requirements and technological opportunities (Eisenhardt and Martin, 2000; Teece, 2007).

Bosch and Wijk (2001) highlight the need to recognize the strong effect managers can have on knowledge-related processes in organizations (cited by Volberda et al, 2010) such as innovation process. Moreover, Nonaka (1994) underlines that external, as a complement to internal sources, of knowledge enhance the firms' innovative capacity. For both modes of knowledge sourcing, the capacity to absorb knowledge is crucial. So, managerial and organizational capabilities are essential in recognizing, assimilating, and, eventually, commercializing the external knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002). Moreover, Cohen and Levinthal (1990) underscore the importance of "critical knowledge", which not only entails technical knowledge, but also includes knowing where "usable complementary expertise resides within and outside the organization" and according to them "this sort of knowledge can be knowledge of who knows what, who can help with what problem, or who can exploit new information". Such critical knowledge may be possessed by managers and further highlights their role as facilitators in the process of knowledge acquisition, transformation and exploitation, that are the dimensions of "realized absorptive capacity" (Zahra and George, 2002). Further, as managers continuously develop theories about the world around them and embed them in their dominant logic, firms' absorptive capacities will be strongly influenced by the cognitive processes of the managers (Volberda et al, 2010). In this vein, Minbaeva, et al., (2003) also talk about the possible managerial influence on absorptive capacity of the organization that is not often examined in the literature. Following this, it is apparent that managerial capacities are a central component of the absorptive capacity of firm that is indispensable in internal and external knowledge sourcing.

Further, we will discuss the implications of various dimensions of managerial demographics for the innovation performance. Managerial demographics refers to the vital statistics related to managers and is conceptualized as follows:

1. MANAGERIAL KNOWLEDGE

According to Volberda et al, (2010), research on absorptive capacity spans theories of learning, innovation, managerial cognition, the knowledge-based view of firms, dynamic capabilities, and co-evolutionary theories. They also underline that the theory on managerial cognition suggests that managers perceive things through their own cognitive lenses (present knowledge). In addition, they cited numerous studies that stereotyped managers as "cognizers", who deal with the environmental complexity by developing mental maps that produce a "dominant management logic", which evolves over time. The aforementioned statement hints at how the knowledge possessed by managers evolves over time, with their experiences, and impact the performance of firms. In the same context, Mintzberg (1994, Pg. 12) argued that managers possess a body of experience that has not only forged a set of skills but also has provided a base of knowledge that has converted into a set of mental models, which ultimately determine his or her style of managing.

Bosch and Wijk (2001, Pg. 160) highlight that "although the concept of managerial knowledge has attracted the interest of management scholars it remains relatively unexplored" and emphasize that it is by "integrating and applying managerial knowledge, however, that managers develop managerial capability...". So, 'managerial knowledge' should be put at the forefront of competitive advantage (Floyd and Wooldridge 1996: Pg. 23).

Moreover, Hamel and Prahalad (1994) emphasizes the role of core competencies in innovation and underlines that one of the feature of core-competency is that it is difficult to imitate. In this context, managerial and organizational innovations are novel managerial capabilities and new organizing principles that assist in "using the existing knowledge-base to carry out combinations that are new to the firm and the industry" (Volberda and Bosch, 2005). Such managerial capabilities are likely to be relatively inimitable and can be considered part of the core competency of the firm. One may counter, noting that a managerial capability, whilst not easily imitable, may be relatively mobile, due to mobility of workers. However, it is the mosaic of managerial capabilities that is inimitable, as it is most beneficial in a particular organizational setting only. Further, such a 'mosaic of managerial capabilities' is the sum of individual managerial knowledge and constitutes organizational knowledge. In the same context, Barney (1994) argues that "at a more general level...managers' experiences, intelligence, and cognitive style may stand the tests of value, rareness, imperfect instability, and imperfect substitutability necessary to be considered a strategic resource" (cited by Bosch and Wijk, 2001; Pg. 163).

It is common to argue that a well-trained and well-educated labour force is significant in achieving competitive economic performance. In order to explain firm-level competitive advantage, Porter (1991, pg. 105) adopts a framework that takes sources of change into consideration. According to this framework, besides "initial conditions", competitive advantage is the result of superior managerial choices and resources. And, environmental uncertainty and differences in the managers' "cognition" are the underlying factors that explain why managerial decisions have differential impact on firms' performances. The term cognition here is used in a much broader context and not just talks about the managerial learning or knowledge but also about their perceptions and other cognitive abilities. However, the present study aims at providing insights into the impact of managerial "knowledge" on a key metric of firm performance: innovation performance. And, managerial knowledge is measured through two dimensions: managerial education and experience. The aforementioned measures are discussed separately.

1a. MANAGERIAL EDUCATION

Successful knowledge accumulation and assimilation is an indicator of efficient innovation capacity. Highly educated personnel, besides in-house R&D activities, are often perceived as the most effective ways to absorb external knowledge and, thus, are often used as a measure of absorptive capacity (Oerlemans and Meeus, 2005). It is the knowledge, that is "embedded in individuals as specific skills or in machines and equipment that are used in the production process" (Maskel and Malmberg, 1999) that helps in successful exploitation of external knowledge. Merely, the presence of the pool of knowledge, skills or other resources are not in and of itself an assurance of success. Porter (1991; Pg.106) argues that managers with a proper understanding of competitive environment and sources of competitive advantages can better search creatively for favourable positions that are different from competitors, assemble the needed skills and assets, configure the value chain appropriately, and put in place supportive organizational routines and a culture that reinforces the required internal behaviour. So, managers hold a central position in competitive equation and their "knowledge", as shaped by their education, influence their choices.

Moreover, well-educated managers have been conjectured to perform better by contributing more rational approaches to decision-making and more creative solutions to complex problems (Bantel and Jackson 1989; cited by Papadakis and Barwise, 2002; Pg 84). And, a well-educated top management team is efficient enough to reach an objectively better solution (Michel and Hambrick, 1992). So, a well-educated top management team can prove beneficial for the innovation process.

Gebreeyesus and Mohnen (2011) cite many studies that indicate that in small firms there exists a positive association between the owner's education and innovativeness because in such cases owner's education has direct bearing on firm-level decisions. Moreover, the Expert Panel Report, Canada (2009) underlines that the significant difference between the number of managerial employees in the United States, relative to Canada, with business degrees is expected to "translate to a difference between U.S. and Canadian businesses, on average, in the propensity to be aware of, and to adopt leading-edge technology and business practices". Such practices have significant effect on the innovation process that, in turn, explains the firm performance.

Furthermore, A firm's absorptive capacity has two elements: prior knowledge and intensity of effort (Kim 2001, Pg. 271), where prior knowledge base refers to existing individual units of knowledge available within the organization (Kim, 2001; Minibaeva, 2003). Liyanage and Bernard (2003, Pg. 86) define firm capability as "synthesis of scientific, technological and managerial skills and knowledge..." that collectively represent the "prior knowledge" of firms. Moreover, employees' ability, their educational background and acquired job related knowledge, partially, represent the "prior-related knowledge" that the organization needs to assimilate and exploit external knowledge (Cohen and Levinthal, 1990; Minibaeva, et al., 2003; Liyanage and Bernard, 2003). Following this, we argue that managerial education is a key constituent of the 'prior knowledge of the firm' that is one component of organizations' absorptive capacity.

Minibaeva, et al., (2003) indicate that absorptive capacity is an important basis for the firm's innovative capability. The level of knowledge in the firm shapes the absorptive capacity. And, as the managerial education level in a firm, in large part, determines the 'prior knowledge of the firm'. One may hypothesise that higher the education-level of managers, the higher is absorptive capacity is likely to be. Gao, et al (2008) observe that firms with higher absorptive capacity are more likely to be innovative than the ones with lower absorptive capacity. Hence, we deduce from the above discussion that the higher the number of managers with a business degree (i.e. higher the level of knowledge), the higher the absorptive capacity and thus, better the innovation performance. For present study, the managerial education is measured through the ratio of managers with M.B.A degree divided by the total number of managers with a firm. I term this the managerial educational ratio and hypothesise that:

H1a: A higher managerial educational ratio is positively associated with both innovation propensity and innovation intensity of firms.

1b. MANAGERIAL EXPERIENCE

Cognitive theories of learning suggest that knowledge structures grow and develop when they are challenged by new information obtained via experience (DeRue and Wellman, 2009). The coexistence of such diverse knowledge structures, in the same individual triggers the sort of learning and problem-solving that results in innovation (Simon, 1985; cited by Cohen and Levinthal, 1990). Moreover, the benefits of diversity of knowledge structures across individuals are at par with the benefits of diversity of knowledge structures within individuals (Cohen and Levinthal, 1990). Accordingly, if there are a higher number of individuals that hail from diverse background and possess such diverse knowledge, it may be argued that there is greater organizational potential for innovation. Furthermore, Reagans and McEvily (2003, p.243) show that people absorb knowledge more easily when they already have some common knowledge in terms of expertise or background characteristics. This, again, brings into focus the role of "prior knowledge" as a dimension of absorptive capacity (Cohen and Levinthal, 1990). Shane (2000; Pg. 452) emphasizes that prior information, whether gained from work experience, education, or other means also "influences the entrepreneur's ability to comprehend, extrapolate, interpret, and apply new information in ways that those lacking that prior information cannot replicate. So, prior knowledge enhances a person's entrepreneurial capacity as well.

Gupta and Govindarajan (2000; Pg. 476) underline that the "extent of prior related knowledge" is one of the contributing factors to the differential absorptive capacities across organizations. As discussed before, the basic premise of absorptive capacity is that the organization needs "prior-related knowledge" to assimilate and use new knowledge and, the presence of diverse knowledge in the form of experienced individuals in a firm indicate that there is higher probability that incoming information will relate to present knowledge stock of the firm. In addition to strengthening assimilative powers, knowledge diversity facilitates the innovation process by allowing individual to make novel associations and linkages (Cohen and Levinthal, 1990, 1994) that can result in innovation. Hence, we can say that individuals' prior related knowledge would facilitate the innovation process at an organizational level. However, DeRue and Wellman (2009) emphasizes that "the experiences rich in developmental challenge are likely to inhibit learning processes by diverting cognitive resources away from learning and toward performance anxieties and evaluation uncertainties" that might adversely impact the innovation capacity of the individual. This implies that managerial experience have equal probability of facilitating as well inhibiting the innovation process that makes the managerial-experience/innovation relationship complex, uncertain and non-linear. Also, it can be argued that specific experience may lead managers to be stringent in their ways and results in diminishing returns.

Moreover, for the present study, we have conceptualized the 'managerial experience' by counting the number of managers that have MNC exposure. Multi-national corporations are considered to be knowledge powerhouse and are termed as a "differentiated network", where knowledge is created in its geographically dispersed establishment and is "transmitted to several inter-related units" (Minibaeva, 2003; Gupta and Govindarajan, 2000). This implies that there are novel flows of knowledge and ideas among the numerous subsidiaries of MNCs in response to numerous problems or bottlenecks that arise either during the usual production or the innovation process. And, access to more cognitive resources result in better problem-solving ability (Denzo and Ross, 2008; Eisenhardt, et al., 1997). So, it can be hypothesised that an individual with MNC experience is more likely to be equipped with problem-solving ability and "prior-related knowledge" that can substantially impact the innovation performance of the firm.

Another line of reasoning for including MNC experience is that it is a qualitative measure of the experience that will indicate the quality of experience received by an individual. As indicated by Petter Gottschalk (2007, Pg. 58) in his book that quantitative measure such as tenure/years of experience provides little insight into the value of experience. Whereas qualitative measures represent the specific nature of work situations that contribute to the richness of the experience construct, such as the variety and breadth of tasks and responsibilities performed in a job, the types of challenges encountered in an assignment, or the complexity of the task. Dawson and Watson (2005) enlist 'work across cultures' and 'work group diversity' as two qualitative measures of an individual's experience, including others. And, MNC experience is likely to entail, working across different cultures and interacting with people from different work domains and geographic locations. So, concluding from above discussion:

H1b: There exists a curvilinear relationship between the number of top and middle managers with MNC experience and the innovation performance.

2. GENDER ROLE

There is limited systematic research focused on the impact of the top and middle female managers on the innovation performance of firms. Denzo and Ross (2008) indicate that there is large gender disparity at senior levels of management in U.S. corporations that raises the question as to whether the firms are capable of identifying and developing managerial talent, which is an important source of competitive advantage. They also bring out from the relevant literature that women have proclivity to manage in "less hierarchical and more interactive style" in comparison to their male counterparts. It can be surmised that presence of women managers can provide teams with wider perspectives that lead to creative thinking and access to more cognitive resources that can result in better problem-solving ability (Denzo and Ross; 2008). This implies that female managers, possibly increase the diversity of knowledge and thus, contribute to the overall absorptive capacity of the firms and, in turn, may have positive impact on the innovation performance.

However, Eisenhardt et al (1997, Pg. 48) point out that "women, minorities and international executives bring yet another set of perspectives" that results in the increase of the range of the viewpoints and is one of the underlying reasons for conflict. Hambrick et al. (1996) also argue that diversity may lead to conflict, which might impede decision-making and thus potentially obstruct performance. However, it is largely argued in organizational behaviour literature that conflict may be beneficial, as it provides for richer sets of solutions for the problem at hand (Eisenhardt et al, 1997). In contrast, it may be unfavourable, as it impedes the speed of decision-making. Both outcomes would have implications for the firm performance.

Furthermore, Denzo and Ross (2008) argue that the presence of female managers below the CEO level has positive impact on firm performance but the presence of a female CEO has a negative/neutral effect. Two studies, McKinsey(2007) and Catalyst (2004), report the role of female managers' participation on firm performance in many organizations globally (cited by 'The Economist' November 2011, Pg. 12). Catalyst (2004) analyzes the performance of fortune 500 companies and observes that "the group with the highest representation of women in top management also had a much better return on equity than those with the lowest" (cited by Dezso and Ross, 2008; The Economist, 2011; Pg 12). McKinsey (2007) studied over 230 public and private companies and non-profit organizations worldwide and documented that "those with significant numbers of women in senior management did better on a range of criteria, including leadership, accountability and innovation, that were strongly associated with higher operating margins and market capitalisation". According to the McKinsey (2007) study, however, a causal relationship is unlikely, but the possibility of a co-relation/association between the concentration of women in middle and higher echelons and the firm performance is frequently found in the studies conducted worldwide.

In contrast, Millward and Freeman (2002) researched the proposition by Skinner (1989) that innovative female managers are more constrained in exhibiting their innovativeness as they are more prone to humiliation and criticism, and also when such behaviour is unexpected and unrelated to their role expectations. They argue that the literature on female managers suggest that women are likely to face different kinds of role expectations than their male counterparts and thus, may be forced to exhibit less innovative behaviour. This, in turn, may make the female managers more "adaptive". Their analysis confirms this thesis but, they also note that female managers tend "to have more original ideas, and less likely to break the rules, though equally likely to risk doing things differently" from their male counterparts. On this basis, these authors argue that male and female managers are equally innovative. However, due to the perception that male managers are innovative whereas female managers are adaptive, there exist a role constraint for female managers and this, to a greater extent, can negatively impact their innovative behaviour, which in turn, have negative implications for the firm's innovation performance.

So, Millward and Freeman (2002) argue that while men and women are equally innovative, their gender role within the context of an organization can affect how they are perceived and eventually impact how they behave when innovating and sharing ideas and "thus, gender roles may interact with the role of the manager to inhibit (in the case of women) or facilitate (in the case of men) the likelihood of innovative behaviour."

Boyd (2008)[3] notes that male and female managers exhibit different risk orientations towards the innovation. Men are expected to be more risk-taking when innovating and sharing ideas and failure is less damaging to men because that's what is expected of them. Women are expected to be risk-averse, and this, apparently, constrain both their proclivity to innovation and their willingness to share innovative ideas. Failure is more damaging for women so they behave more adaptively in innovation exercises. Such differing behavioural pattern can have both positive and negative impact on the innovation process. Nevertheless, he emphasizes that the adaptive behaviour/risk-averse behaviour in women and more risk-taking behaviour in men "provides a certain balance or harmony in innovation process". So, drawing upon the preceding discussion, we argue that there is a non-linear relationship between the number of female managers and the innovation performance of a firm suggesting that too many female managers are not beneficial for the innovation performance. So, we hypothesize:

H2. There is a curvilinear relationship between the number of female managers and innovation performance of firms such that female managers initially bring a diversity of perspectives, but

[3] Website: http://www.innovationinpractice.com/innovation_in_practice/2008/03/gender-role-in.html

too high a proportion of female managers may result in conflict that can hinder the innovation process.

According to Kilduff, et al. (2000), usually demographic approach studies cognitive diversity in terms of proxy variables such as gender, age, organizational tenure, ethnicity, et al. Whereas, the cognitive approach studies the cognitive diversity through direct questionnaire "using measures of attitudinal and normative differences between individuals who may be homogenous on demographic indicators". Also, it is emphasised that demographic variables such as gender are said "to be more objective, to yield more parsimonious explanations of organizational phenomenon, and to be more easily submitted to testing than cognitive variables.

3. LEADERSHIP-ROLE

Horth and Buchner (2009) describe three tasks of leadership. These are setting direction, creating alignment, and building commitment. According to them "when direction, alignment and commitment are created around innovation, organizations emerge as more productive and more innovative". Considering the potential of top managers/CEO to substantially impact the course of organizational innovation, as will be illustrated in subsequent discussion, it is important to consider the role of leadership vis-a-vis other demographic characteristics related to managers. So, we have conceptualized 'leadership role' through top manager's total years of experience in the sector.

Yadav, et al (2007) underline that innovation is fundamental to the survival and success of firms, and the primary charge of CEOs is the survival and success of their firms. Therefore, it can be argued that CEOs play a leading role in promoting innovation in their firms. However, the literature hold both negative and positive points of view about the CEOs role in innovation. Yadav, et al (2007, pg. 84) highlight studies that emphasize that "...CEOs are frequently so steeped in the past or in their day-to-day activities that they fail to recognize that the technological environment has turned on them" and also note that the "... extremely high levels of job demands may squeeze out novelty and fresh thinking". So, according to them, "perhaps a more charitable view of the impact of CEOs on innovation is that they are simply not very relevant in driving innovation in the firm" and that "... CEOs have an effect on innovation but that this effect occurs at the project level through their support of individuals and teams working on individual projects".

3a. TENURE

Tenure has been argued to foster a reliance on tried and tested decision-processes (Katz, 1983). McCall (2004) states that "the primary source of learning to lead, to the extent that leadership can be learned, is experience". He also emphasizes that the role played by training and other formal programs is relatively modest in comparison to other types of "on-job-experiences". Horth and Buchner (2009) underscore the view that an organizational culture that encourages innovation is one whose leader/s actively remove organizational barriers to innovation such as internal political problems, evasion of new ideas, unfavourable internal competition, etc. In this regard, it can be argued that long-tenured CEOs favour standardized communication patterns (Katz, 1982; Smith et al., 1994; Papadakis and Barwise, 2002) and over time they tend to form a top-management team of their own choosing. Thus, minimising internal political debates

(Finkelstein and Hambrick, 1990; Halebian and Finkelstein, 1993) and encourage quick decision-making.

Moreover, innovation becomes a priority only when people are given access to appropriate resources, including funds, materials, facilities and information. CEOs, after many years may come to possess "critical knowledge" (Cohen and Levinthal, 1990) of where to look for a particular resource or important information and when and how to react to a particular change. In this context, it can be said that top managers with higher experience are expected to know when the firm should perform the innovation and to efficiently steer the course of innovation so as to achieve higher innovation performance. Hence, top Manager's total years of experience in the sector may have a positive bearing on firms' innovation, and in turn, growth of the firm. Accordingly, we hypothesize that:

H3. Higher total years of experience of top manager working in the sector would enhance the innovation performance of firms.

4. MANAGEMENT RATIO

According to Davison (2003, pg. 22), managerial effectiveness and accountability remain a strong focus for organizational studies and, in order to achieve business goals and get successful in the volatile and uncertain environment facing the firms, "companies cannot be top heavy or have management stretched too thin". Davison also emphasizes that the search for the right balance of employees to managers what is called "span of control" or "management ratio", is critical as well as difficult to achieve. From a quantitative point of view, management ratio can be calculated by dividing a company's headcount by its management headcount (Davison, 2003). The same definition of management ratio (MR) is adopted in the present study. Due to the unavailability of data related to number of lower level managers and supervisors, we have considered the ratio of Establishment size to the number of top and middle managers termed as TAMM (Top and Middle Management) ratio. Thus, we only consider the impact of upper and middle management on innovation performance.

$$TOP\ AND\ MIDDLE\ MANAGEMENT\ RATIO = \frac{Establishment\ Size}{Number\ of\ Top\ and\ Middle\ Managers}$$

It is largely established in organizational studies and innovation literature that strategic decision-making is done at the higher echelons of organization, called "strategic apex" (term coined by Mintzberg, 1979), and this strategic decision-making at the top have bearing on the entire organizational performance (Bandiera, et al., 2012).Middle-line managers, in contrast, facilitate the implementation of strategic decisions (Mintzberg, 1979). Accordingly, the focus on upper and middle managers has merit in studying innovation performance.

As each manager's span of control is broadened, that is a higher MR, the lower the number of layers of management there are and the less closely supervised each employee will be (Davison, 2003). On the other hand, a low Management Ratio (henceforth MR) implies that there are relatively more managers to employees, resulting in closer supervision and control. This may prove beneficial in meeting customer-set deadlines and ensuring faster communication (Hattrup and Kleiner, 1993). A lower MR removes one of the constraints to innovative behaviour that is communication gap (Rosenfeld and Servo, 1990). Hence, a lower MR would possibly enhance the innovative capabilities of firms.

However a more common argument would note that today's workplace is characterised by "diverse skills and experience where many employees require more freedom in general, and in particular, the freedom to perform without someone looking over their shoulders" (Davison, 2003). They need more autonomy, more control over their work environment and are more likely to be self-monitored. Such a work environment with a high MR would undoubtedly provide greater scope for individuals to develop creative thinking and to find innovative solutions to problems (Hattrup and Kleiner, 1993; Davison, 2003). This, not only increases the absorptive capacity of the firms (Cohen and Levinthal, 1990), but also, encourages "Intrapreneurship". Intrapreneurship refers to "employee initiatives in organizations to undertake something new, without being asked to do so" (Jong and Wennekers, 2008). That is an "Intrapreneur" focuses on innovation and creativity, and transform ideas into an innovations, within organizational environments.

There are other advantages of higher MRs from a managerial perspective. Davison (2003) emphasizes that if managers are leading large instead of small units, they have greater opportunity to learn and practice their management skills. She further emphasizes that "with more managerial autonomy and fewer administrative duties, managers are expected to be innovators, who continually look for ways to add value to the company's products and services, and improve customer satisfaction". Also, "flatter management structures can mean more streamlined decision-making processes, which in turn, mean fewer bureaucratic logjams and faster business response times" (Davison, 2003). So, a higher MR, is not only advantageous for overall performance but also beneficial for innovation process.

Summarizing the preceding discussion, one might expect to observe a nonlinear impact of MR on innovation performance. As suggested by Meier and Bohte (2000), there is a curvilinear relationship in which initial increases in span of control lead to increases in organizational performance, though at a decreasing rate of return (cited by Theobald and Nicholson-Crotty, 2005; Pg. 649). However, "there may be an optimum span of control for the production of one goal, but this may not be optimum for the production of another goal within the same organization" (Nicholson-Crotty, 2005; Pg. 649). In this vein, it can said that there might be an optimum 'Management Ratio' (MR) for achieving highest innovation intensity, that is, one of the many goals of the organization. Hence:

H4. An inverted u-shaped relationship is expected between the management Ratio and the innovation performance of firms; displaying initially increasing returns followed by diminishing returns.

Below is the summarised conceptual model for the study:

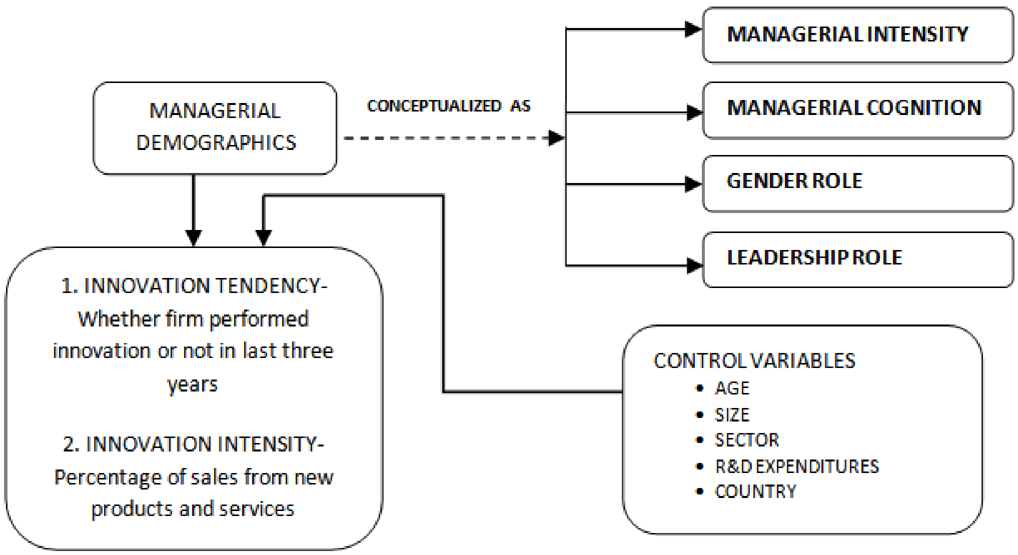

Figure 1. THE RESEARCH MODEL AND CONCEPTUALIZATION OF MANAGERIAL DEMOGRAPHICS

III. METHODOLOGY

1. DATA & SAMPLING

The data was obtained from Management, Organization and Innovation (MOI) Survey 2009, a joint initiative of the European Bank for Reconstruction and Development (EBRD) and the World Bank Group. The MOI survey was undertaken for the first time in 2008-2009, covering 1,777 manufacturing enterprises in 12 countries. For the present study, we have included data from all 12 countries. The MOI survey collected data from the manufacturing sectors in selected EBRD countries of operation and Germany. The objective of the survey was to measure and compare management practices across developing countries, with Germany included as a developed country benchmark; to assess the constraints to private sector growth and enterprise performance resulting from management practices; to stimulate policy dialogue on management practices and innovation; and, to help shape the agenda for reform.

The survey authority used random sampling to generate a sample representative of the manufacturing sectors in each country and to have large enough sample sizes to conduct statistically robust analysis with levels of precision at minimum 7.5% precision for 90% confidence intervals.

For the analysis, our primary focus is on data corresponding to two key questions addressing the innovation performance of the countries under study (see table 2):

1. In the last three years, has this establishment introduced new products and services? (Yes/No). (Questionnaire, Pg. 20)

The above question from present survey is adapted from a question asked in European Community innovation survey questionnaires and is based on a concept of innovation-as-output envisaged in OECD Oslo Manual. Using the data related to above question, we will examine the impact of managerial demographics on the 'occurrence of innovation' or in other words the propensity of firms to perform product innovation.

2. In last fiscal year, what percentage of this establishment's annual sales was accounted by new products or services that were introduced in the last three years? (Questionnaire, Pg. 20)

Data generated by responses to above question will be used to analyse the impact of managerial demographics on the 'scale of innovation'. The same definition of innovation intensity can be found in Mohnen and Dagenais (2000) review of various conceptualizations of innovation intensity. It should be noted here that 'innovation intensity' is an output indicator that reflects past innovation efforts of a firm. Output indicators have the advantage over the input indicators as they measure "the success of innovation, that is, indirectly to give more weight to innovation efforts that turn out successful" (Mohnen & Dagenais, 2000; Pg. 18). Moreover, Freel (2005, pg. 102) quoted Sirilli and Evangelista (1998, pg. 890) who indicated the difficulties in relating innovation inputs to outputs - "because resources used in the innovation process are only partly reflected in identifiable new products and services". Even the Oslo Manual (OECD, 1997) emphasize the same suggesting the "measurement of the impact of innovation through the share of sales linked to new products and services", and this definition helps in viewing innovation as a commercial phenomenon rather than a technological one (Freel, 2005). However the question doesn't tells whether the sales come from radical innovation or incremental innovation or the sales come from innovation that is new to firm or new to the sector. Thus, the question fails to measure the managerial influence in a broader and more accurate context.

Two models are developed corresponding to the above questions. These are further discussed in the methodology section.

2. MEASURES

2a. PREDICTOR VARIABLES

The same set of predictor variables are used for analyzing the innovation propensity and innovation intensity. It should be noted here that we have totalled the number of full-time top and middle managers that have a business degree either from the home country or from the foreign country and calculated the values using the percentage given for the related questions (Questionnaire, Pg. 12). Further, 'Education Ratio' for managers is defined by dividing the establishment size by the total number of top and middle managers with a business degree.

TABLE 1: PREDICTOR VARIABLES

PREDICTOR VARIABLES	CONCEPTUALIZATION
MANAGEMENT RATIO[4]	Establishment Size/Total numbers of full-time top and middle managers in the establishment.
GENDER ROLE[5]	Total number of full-time, top and middle managers that are female.
MANAGERIAL KNOWLEDGE	1. MANAGERIAL EDUCATION RATIO: Establishment Size/Total number of full-time top and middle managers that have a business degree either from the home country or from the foreign country. 2. MANAGERIAL EXPERIENCE: Total number of full-time top and middle managers that have worked with a multinational before working in the present establishment.
LEADERSHIP ROLE	1. TENURE: Total number of years of experience of the establishment's Top manager

It should be noted here that we have centered[6] the quadratic terms of management ratio and number of managers with MNC experience because, centering reduces multi-collinearity[7] to some extent.

2b. PREDICTED/OUTCOME VARIABLES

Predicted/dependent values differ for two models as shown in table 2 below:

[4] A quadratic term i.e. square of the 'Management Ratio' is introduced in the analysis to account for the curvilinear effect of the variable.
[5] A quadratic term i.e. square of the 'Female managers' is introduced in the analysis to account for the curvilinear effect of the variable.
[6] Centering involves deducting mean value from the values of variable, thus, making 0 the centre of values.
[7] http://www.ats.ucla.edu/stat/mult_pkg/faq/general/curves.htm

TABLE 2: PREDICTED/OUTCOME VARIABLES

	QUESTION FROM THE SURVEY QUESTIONNAIRE	**PREDICTED VARIABLE**
MODEL A	Whether the firm performed the innovation in last three years?	Firm performed innovation or not. (Yes/No)
MODEL B	What percentage of this establishment's annual sales was accounted for by new products or services that were introduced in last three years?	Innovation Intensity (0%-100%)

Binary logistic regression is used to analyze the Model A. And, for Model B, the dependent variable 'innovation intensity' is a percentage value and as such it ranges between 0 and 100. Accordingly, 'tobit regression' is performed in order to account for censoring as use of OLS would have resulted in over/under estimated coefficients.

2c. CONTROL VARIABLES

According to Tabachnik and Fidell (2001), in a regression equation, the researcher might want to account for any confounding effects using control variables. In the present study, the covariates or control variables will be entered into the regression with the independent variables. There are five control variables used in the analysis to take into account their confounding effect on the outcome variable. These are all 'usual suspects' in the innovation studies that models firm-level innovation performance.

FIRM-SIZE

In the model we control for firm size. Firm size has been shown to affect innovation capacity, as indicated in several empirical studies, although, the results are so far inconclusive and, a positive association between size and innovation is justified on the ground that size might capture resource availability (Strecker, 2009). We define size of the firm by the number of full-time employees in the establishment. Survey covered the establishments with size varying from 50 to 5000.

FIRM AGE

The age of the firm, calculated as the number of years since a firm's foundation till 2009 (year of data collection), measures firm experience and learning, and is commonly used variable in empirical studies of innovation. Higher age implies that there is an accumulated knowledge present in the firm in a form of codified information that can influence the innovation performance as well (Santamaria, et al., 2010).

RESEARCH AND DEVELOPMENT

Innovation begins with firms' formal and informal R&D effects. R & D activity is generally conceptualized as an input to the innovation process and can have substantial influence on the innovation performance of firms (Strecker, 2009). For the current study, R&D activity is measured through R & D expenditures of the firms (Questionnaire, Pg. 20). R & D expenditure is a basic measure that covers intramural as well as extramural expenditures, in other words, all expenditures for R & D that are performed for a firm.

SECTOR CLASSIFICATION

An inter-sectoral research approach is chosen in order to derive comprehensive and context independent conclusions concerning the 'managerial-demographics' and 'innovation-performance' relationship. It is done because by categorizing firms by technology intensity allows us to control for the impacts of different technology levels faced by a particular firm belonging to a particular sector, can have on innovation performance. This allows us to predict the outcome variable as if in similar technology environments. There are 11 manufacturing sectors reported in questionnaire. Considering the OECD classification of Manufacturing industries on basis of technological level (2005; Annex A, Pg. 181), we have divided the firms in Low-Tech, High-Tech, L-M-L (i.e. Low tech to Medium-Low tech sector) and H-M-H (i.e. High tech to Medium-High tech sector). (see table 3)

Table 3: SECTOR CLASSIFICATION

		Freq.	Percent	Valid Percent	Cumulative Percent
Valid	Low Tech	987	55.5	55.5	55.5
	L-M-L	429	24.1	24.1	79.7
	H-M-H	280	15.8	15.8	95.4
	High Tech	81	4.6	4.6	100.0
	Total	1777	100.0	100.0	

COUNTRY CODE

The countries from survey are dummy-coded and included in tobit regression and are included as categorical variables in logistic regression so as to control for country effect on the innovation performance and get results independent of the context (see table 4).

Table 4: COUNTRIES FROM MOI SURVEY

COUNTRIES IN SURVEY	**NUMBER OF FIRMS REPORTED FOR EACH COUNTRY**
BULGARIA	154
UKRAINE	147
UZBEKISTAN	123
BELARUS	102
ROMANIA	152
POLAND	103
LITHUANIA	100
KAZAKHISTAN	125
INDIA	200
SERBIA	135
RUSSIA	214
GERMANY	222
TOTAL NUMBER OF FIRMS	**1777**

3. VALIDITY OF MEASURES

Multicollinearity in logistic regression models is a result of strong correlations between independent variables. The existence of multicollinearity inflates the variances of the parameter estimates. That may result, particularly for small and moderate sample sizes, in lack of statistical significance of individual independent variables while the overall model may be strongly significant. So, we have adapted the three approaches from Strecker (2009) study that are correlation matrix, tolerance/VIF (Variance Inflation Factor) and condition index to validate the formative constructs of the survey.

- **Correlation matrix:** This is the easiest method to reveal collinearity. The correlation matrix is calculated for all items of a certain construct and all . And, correlations of over 0.9 are clear indications for collinearity. For correlations beyond 0.7 the affected items should be verified in respect of content (Strecker, 2009). For present study, correlations for the three quadratic terms are approx. 0.8, but less than 0.9. Also, the correlation matrix approach can only identify linear dependencies between two variables but not between three or more (see Table 5).

Hence, following additional methods are used.

- **Tolerance/Variance Inflation Factor (VIF):** The tolerance measure is defined as the portion of the variance which cannot be explained by the other indicators. It is the difference between one and the coefficient of determination (R). VIF is defined as the reciprocal value of tolerance. For perfect linear independency, tolerance reaches its maximal value of one and VIF its minimal value of one. VIF should not exceed a threshold value of 10, which corresponds to a multi-collinearity of 0.95 (Strecker, 2009). For present study, none of the variables exceeded the threshold of 10 as indicated. The tolerance/VIF approach does, however, not provide any information about the number of linear dependencies and the involved variables.
- **Condition index:** To address the weakness of the tolerance/VIF approach Belsley (1994) developed the condition index. The condition index is a measure of near-dependencies. A high condition index indicates the existence of near-dependencies. For the condition index, Belsley (1994) suggests a threshold value of 30 (Strecker, 2009).

Applying the thresholds as discussed above, no serious collinearity problems can be identified with any of the independent variables except for the three quadratic terms for management ratio, number of female managers and number of managers with MNC experience that have high correlations with their respective original variables. The main concern is that such high correlations may infuse multi-collinearity into the regression. Given this concern, various sensitivity analyses to ensure the robustness of the results. First, we performed hierarchical regression and entered quadratic terms and their original variable in different orders. The results (i.e the significance of variables) did not change substantively. Finally, we explored the variance inflation (VIF) contribution of each of the independent variables. All were well within the acceptable range i.e. less than 10. As a result, we can say that interpretations of the findings do not change or the results are not biased.

TABLE 5. DESCRIPTIVE STATISTICS, MULTICOLLINEARITY DIAGNOSTICS AND CORRELATIONS.

	VARIABLES	Mean	St. Dev.	1	2	3	4	5	6	7	8	9	10	TOL.	VIF	CON. INDEX
1	SIZE OF THE ESTABLISH MENT	18.5976	22.720											.635	1.574	1.000
2	AGE OF THE ESTABLISH MENT	290.8734	449.23	.032										.995	1.005	1.341
3	R&D EXPENDITU RE	129.5280	420.82	-.013	-.007									1.00	1.000	1.394
4	MANAGEM ENT RATIO	1.2641E9	2.2E10	.359	.011	-.012								.253	3.946	1.613
5	QUADRATIC MANAGEM ENT RATIO	31.2243	48.96	.301	.002	-.005	**.830**							.298	3.360	1.843

6	FEMALE MANAGERS	14.2770	20484	.392	.043	.000	-.155	-.054						.238	4.209	1.911
7	QUADRATIC FEMALE MANAGERS	7.12	16.332	.294	.017	-.002	-.057	-.018	**.833**					.288	3.467	2.004
8	MANAGERIAL EDUCATION RATIO	317.25	2751.4	-.019	.004	-.005	.041	.002	-.051	-.023				.968	1.034	2.782
9	TOTAL NUMBER OF MANAGERS WITH MNC EXP	1.6928	8.202	.051	.009	-.001	.010	-.009	.005	.003	.085			.138	7.232	4.454
10	QUADRATIC MANAGERS WITH MNC EXP	.4057	665.45	.009	.014	-.003	.014	-.004	-.008	-.007	.031	**.825**		.140	7.166	4.521
11	TOP MANAGER'S EXPERIENCE	17.560	10.968	.050	-.016	-.001	.089	.062	-.061	-.024	-.019	.020	.017	.984	1.016	6.496

Also, In some cases, it is advised to simply leave multicollinear variables in the model. These cases include variable inclusion principle i.e. whenever you include higher order terms such as quadratic terms in a model, you will also include the implied lower order terms. For example, if you include X^2 in the model, you have to include X too in the model. And the two will have high correlation.[8]

4. METHODOLOGICAL CONSIDERATIONS

For this study, the unit of analysis is establishment, that is, an entity that may or may not be a part of a larger firm. Our aim is to account for the managerial role in innovation regardless of whether it is a firm or an establishment. The survey report notes that there is no redundancy and no firm is accounted/surveyed twice. For the current research, the impact of managerial demographics on innovation performance is analyzed in two steps, outlined below:

[8] http://courses.ttu.edu/isqs5349-westfall/images/5349/multicollinearity_99.htm

TABLE 6: FREQUENCY ANALYSIS: WHETHER FIRM PERFORMED INNOVATION? 1=Yes, 0= No

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	596	33.5	33.7	33.7
	1	1173	66	66.3	100.0
Missing	SYSTEM	8	.5		
	Total	1777	100.0	100.0	

4a. [9]MODEL A: BINARY LOGISTIC REGRESSION

By using the logistic regression model, we aim to analyze whether the managerial demographics are associated with the occurrence of innovation in the manufacturing sectors of the 12 countries under study. Considering that the data, corresponding to the question whether the firm performed innovation or not in last three years, is dichotomous, we have employed logistic regression. The predicted value is not a prediction of the output value, as in linear regression, rather, it is interpreted as probabilities of belonging to one of two output conditions that is (1 if firm performed innovation and 0 if firm did not perform innovation; the firm counts is shown in table 6), and the probability can take any value between 0 and 1 rather than just two former outcomes.

Instead of using a least-squared deviations criterion for the best-fit, logistic regression uses a maximum likelihood method, which maximizes the probability of getting the observed results given the fitted regression coefficients. Further, mathematical transformation – a log

[9] http://www.uk.sagepub.com/burns/website%20material/Chapter%2024%20-%20Logistic%20regression.pdf

transformation – is needed to normalize the distribution. This log transformation of the probability values, say p, to a log distribution enables us to create a link with the normal regression equation. The log distribution (or logistic transformation of p) is also called the logit of p or logit(p). Logit(p) is the log (to base e) of the odds ratio or likelihood ratio that the dependent variable is 1. It is defined as:

$$logit\ (p) = \ ln[p/(1 - \ p)]$$

Whereas p can only range from 0 to 1, logit(p) scale ranges from negative infinity to positive infinity and is symmetrical around the logit of .5 (which is zero)[10].

Below is shown the relationship between the usual regression equation (a + bx … etc.), which is a straight line formula, and the logistic regression equation for our study. The form of the logistic regression equation is:

$$logit\ [p(y_{innov})] = \log \frac{p(y_{innov})}{1-p(y_{innov})} = \beta_0 + \ \beta_1 x_1 + \ \beta_2\ x_2 + \ \beta_3 x_3 + \ \beta_4 x_4 + \ \beta_5 x_5 + \cdots + \beta_{25} x_{25} + \ \varepsilon$$

$where, p(Y_{innov})\ is\ the\ probability\ that\ case\ is\ in\ a\ particular\ category, where\ 1\ indicates\ that$

$a\ firm\ is\ involved\ in\ innovation\ in\ last\ three\ years$

$\beta_1 - \beta_{25}\ are\ coefficients\ of\ predictor\ variables\ including\ \ control\ variables$

$x_1 - x_{25}\ are\ 8\ predictor\ variables\ and\ rest\ control\ variables$

$\beta_0\ is\ constant$

$\varepsilon\ is\ error\ term$

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[10] http://www.uk.sagepub.com/burns/website%20material/Chapter%2024%20-%20Logistic%20regression.pdf
The binary logistic regression model computes the probability of the selected response as a function of the values of the explanatory variables. A major problem with the linear probability model is that probabilities are bounded by 0 and 1, but linear functions are inherently unbounded. The solution is to transform the probability so that it is no longer bounded. Transforming the probability to odds removes the upper bound and natural logarithm of odds. also removes the lower bound. Thus, setting the result equal to a linear function of the explanatory variables yields logit or binary response model (Sarkar et al. 2010).

Also, the probability of the outcome can be calculated from predictor variables by using the following logistic function:

$$p(y_{innov}) = \frac{exp^{(\alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots)}}{1 + exp^{(\alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots)}}$$

4b. MODEL B: TOBIT REGRESSION

[11]The tobit model, also called a censored regression model, is designed to estimate linear relationships between variables when there is either left- and/or right-censoring in the dependent variable (also known as censoring from below and above, respectively). Censoring is a defect in the sample - if there were no censoring, then the data would be a representative sample from the population of interest. Considering that the data at hand for the present study is censored, we have used tobit regression.

Censoring from above takes place when cases with a value at or above some threshold, all take on the value of that threshold, so that the true value might be equal to the threshold, but it might also be higher. In the case of censoring from below, values those that fall at or below some threshold are censored. It is done because of the following reasons:

– If we include the censored observations as *innovation intensity* = 0, the censored observations on the left will pull down the end of the line or for *innovation intensity* =100%, the censored

[11] http://www.ats.ucla.edu/stat/r/dae/tobit.htm

observations on the right will pull down the end of line, resulting in underestimates of the intercept and overestimates of the slope.

– If we exclude the censored observations and just use the observations for which *y*>0 (that is, truncating the sample), it will overestimate the intercept and underestimate the slope.

– The degree of bias in both will increase as the number of observations that take on the value of zero increases.

The tobit model uses all of the information, including information on censoring and provides consistent estimates. It is also a nonlinear model and is estimated using maximum likelihood estimation techniques. The likelihood function for the tobit model takes the form:

$$Log\ L = \sum_{Y_i>0} -1/2\left(\log(2\pi) + log\ \sigma^2 + \frac{(Y_i - \beta X_i)^2}{\sigma^2}_{n}\right) + \sum_{Y_i=0} \log\left(1 - F\frac{\beta X_i}{\sigma^2}\right)$$

This above shown is an unusual function, it consists of two terms, the first for non-censored observations, and the second for censored observations (it is the cdf). The estimated tobit coefficients are the marginal effects of a change in x_i on y*, the unobservable latent variable and can be interpreted in the same way as in a linear regression model. But such an interpretation may not be useful since we are interested in the effect of X on the observable y (or change in the censored outcome). It can be shown that change in y is found by multiplying the coefficient with $Pr(a<y^*<b)$, that is, the probability of being uncensored. Since this probability is a fraction, the marginal effect is actually attenuated. In the latter, a and b denote lower and upper censoring

points, which for present study means left and right censoring, the limits will be: a =0, b=100. Following (table is the censoring observation summary for the variable innovation intensity.

Table 7: OBSERVATION SUMMARY

LEFT-CENSORED OBSERVATIONS AT INNOVATION INTENSITY<=0	605
UNCENSORED OBSERVATIONS	1129
RIGHT-CENSORED OBSERVATIONS AT INNOVATION INTENSITY>=100	35

IV. RESULTS

We tested the conceptual model using SPSS. Table 8 presents the results for Model A and Table 9 reports the result for Model B. It should be noted here that we haven't tabulated the statistics related to control variables in the subsequent sections, but all results are listed in appendix A.

MODEL A

Binary logistic regression analysis was conducted to predict the tendency of the firms to perform innovation using 25 predictor variables, including control variables. A test of the full model against a constant only model is statistically significant, indicating that the predictors as a set reliably distinguished between firms that performed innovation and the ones that did not performed innovation (chi square = 410.769, p= .000 with df = 25). Moreover, Hosmer-Lemeshow model test, also indicates that we have a good regression model (chi square = 7.702, p = .463, with df = 8) that is there is not much difference between the predicted and observed values (as indicated by the non-significant p-values) that indicates a better model fit. Nagelkerke's R^2 value of 0.287 indicate that regression model is moderately useful in terms of its prediction ability or rather discriminating between the two categories of innovation performance. Also, overall prediction successes as indicated by the classification table is 73.3%. This is quite high and indicates a high usefulness of the model in terms of its prediction power.

Finally, the coefficients in the regression model indicate that two variables: 'number of top and middle female managers' and 'number of managers with MNC experience' are statistically significant in predicting the probability of firms' performance of innovation, with p-values of 0.075 and 0.001 respectively. The number of female managers positively impact the tendency of firm to perform innovation and has a predictive ability (as suggested by odds ratio) almost twice of the variable, 'number of managers with MNC experience', which also positively impacts the tendency of the firm to perform innovation. The results shows that the quadratic term for the variable 'total top and middle managers with MNC experience' is statistically significant too showing that there is a positive curvilinear relationship between the variable and the innovation intensity of the firm. A stylised version of the relationship would somewhat look like the one below:

Fig. 2 Curvilinear relationship between Quadratic term MNC experience and innovation intensity

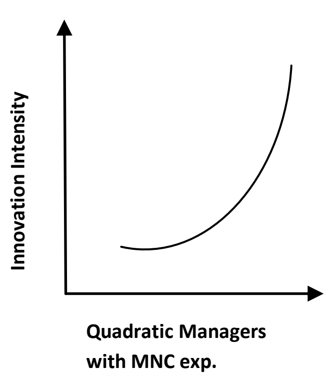

Table 8 : MODEL A-BINARY LOGISTIC RESULTS

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
STEP 1	No. of top and middle female managers	.019	.011	3.160	1	.075*	1.019	.998	1.040
	Quadratic No. of top and middle female managers	.000	.000	2.435	1	.119	1.000	1.000	1.000
	No. of top and middle managers with MNC experience	.090	.026	11.433	1	.001***	1.094	1.038	1.152
	Quadratic No. of top and middle managers with MNC experience	.000	.000	8.844	1	.003**	.999	.999	1.000
	Management Ratio	-.004	.004	.909	1	.340	.996	.989	1.004
	Quadratic Management Ratio	.000	.000	1.329	1	.249	1.000	1.000	1.000
	Managerial Education ratio	-.030	.061	.241	1	.624	.971	.861	1.094
	Top manager's years of experience	.006	.006	.976	1	.323	1.006	.995	1.017
	Nagelkerke's R^2	.287							
	-2 log-likelihood	1849.9							
	$(\chi^2)^d$ (p-value=0.000)	410.77							
	Overall Classification accuracy	73.3%							

***p<=0.1 **p<=0.05 ***p<=0.001**

[d] **Full model vs. constant only model. Figures in parentheses are Wald χ2-test statistics.**

MODEL B

A tobit regression is conducted to analyse the impact of the explanatory variables on the innovation intensity achieved from new products and services introduced in last three years. A test of the full model against a constant only model is statistically significant, indicating that the predictors, as a set, reliably analysed the impact on the innovation intensity (-2 Log Likelihood= 5953.56, chi square = 273.27, p = 0.0000 with df = 24). Pseudo R^2 of 0.0224 and indicate that model is moderately useful. The t-test statistic evaluates whether or not the independent variables are statistically significant in explaining the outcome variable. Finally, the coefficients for regression model indicates that the two variables: 'number of top and middle female managers' and 'number of managers with MNC experience' are most significant in predicting the innovation intensities of firms, with p-values of 0.060 and 0.003 respectively. Both the variables positively impact the innovation intensities of firms. The results shows that the quadratic term for the variable 'total top and middle managers with MNC experience' is significant too showing that there is a negative relationship between the variable and the innovation intensity of the firm. However, the quadratic term for the number of female managers seems notable considering that the generally followed significance levels are arbitrary and there is no established rule that states they are totally reliable. But, it is always better to account for variables that are at or below the set significance levels. However, looking at the p-value of 10.7% which is very close to the acceptable 10% significance level, we have taken into account the quadratic term for the variable, number of female managers. The stylised representation of the graph for the quadratic terms of the variables: number of managers with MNC experience and number of female managers as per the sign of respective variable's coefficient is shown below

Fig. 3

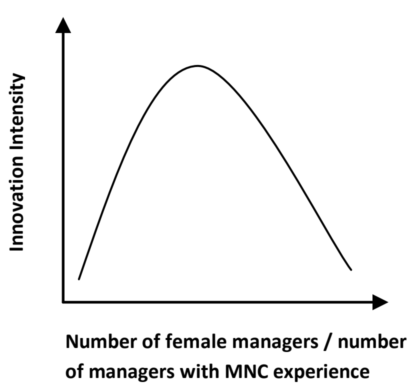

Table 9: TOBIT REGRESSION RESULTS

		Coeff.	S.E.	t-statistic	Sig.	95% C.I.	
						Lower	**Upper**
STEP 1	Management Ratio	-.02796	.03339	0.84	0.402	.0934604	.03753
	Quadratic Management Ratio	.0000567	.000068	.83	.404	-.000077	.00019
	Female managers	.2034379	.1082462	1.88	.060*	-.008868	.4157438
	Quadratic Female Managers	-.0010863	.000674	-1.61	.107	-.002408	.0002357
	Top manager's years of experience	.1049731	.0739562	1.42	.156	-.040079	.2500252
	Managerial Education ratio	-.2139507	.7961862	.27	.788	-1.34763	1.77553
	No. of top and middle managers with MNC experience	.753069	.2491369	3.02	.003**	.2644307	1.241707
	Quadratic Managers MNC Experience	-.0080252	.0030565	-2.63	.009**	-.01402	-.0020304
	Pseudo R^2	0.0224					
	Log likelihood	-5953.56					
	LR $chi^2(24)$	273.27***					
	Log likelihood	-5953.56					

***p<=0.1 **p<=0.05 ***p<=0.001**

V. DISCUSSION AND CONCLUSION

Previous studies have highlighted the gap in innovation literature regarding the managerial role in the innovation. To address this gap, the present research examined the relationship between the managerial demographics and innovation performance.

The empirical analysis suggest that 'number of top and middle female managers' is significant in encouraging innovation in firms as well as positively impact the innovation intensity of firms (see table 8 & 9). An earlier study by Denzo and Ross (2008) reports that there is a positive association between firm performance and female participation below the CEO position and, found evidence for a "female management style" that enhances firm performance by facilitating teamwork and innovation. In the same vein, present study reports that in the manufacturing firms, the number of female managers in the top and middle echelons of the management is significant and have a positive impact not only on the propensity of the firms to perform innovation, but also on innovation intensity i.e. an output measure of innovation performance. This is quite interesting finding, keeping in mind, the emerging niche for female managers in organizations today.

However, this result undermines the argument by Millward and Freeman (2002) who suggested that the female managers are constrained in their innovative behaviour due to their role expectations and thus, can negatively impact the innovation performance of the firm. Accordingly, our suggestion is in line with that of Denzo and Ross (2008), given the fact that not many firms have women in the higher positions (The Economist, 2011), it is advised that firms should identify and recruit female managerial talent, that can prove to be a source of competitive advantage for the firms as it enhances innovation performance. But, the present study doesn't report as to what attributes of "female management style" are important per se.

Finally, findings show that the number of managers with MNC experience have a positive impact on both, the propensity of the firms to perform innovation and the innovation intensity. However, the quadratic terms of the variable portray a dissimilar curvilinear relationship with the two measures of innovation performance i.e. a positive/convex relation with the firms' propensity to innovate (fig. 4) and a negative/concave relation with the innovation intensity of firms (fig. 5). The result conforms to the hypothesis posited (discussed in section II), according to which an inverted u-shaped relationship exists between Managerial MNC experience and innovation performance of firms. So, the present study confirms that the presence of diverse knowledge in the form of experienced individuals in a firm indicate that there is higher probability that incoming information will relate to present knowledge stock of the firm and, in addition to strengthening assimilative powers, knowledge diversity facilitates the innovation process by allowing individual to make novel associations and linkages (Cohen and Levinthal, 1990, 1994). Therefore, it can be said that individuals' prior related knowledge would both encourage the innovation and facilitate the innovation process at an organizational level. Moreover, the present study also confirms the proposition by DeRue and Wellman (2009), that emphasizes that "the experiences rich in developmental challenge are likely to inhibit learning processes by diverting cognitive resources away from learning and toward performance anxieties and evaluation uncertainties" that might adversely impact the innovation capacity of the individual. Also, increase in the number of managers with specific experience is, initially, associated with increased returns, but eventually accompanies diminishing returns. It implies that managerial experience have equal probability of facilitating as well as inhibiting the innovation performance as confirmed by the results. In light of the preceding discussion, we can conclude that there are same sets of managerial capacities that are significant in explaining the two different measures of innovation performance for manufacturing firms in 12 countries.

However, it is surprising to note that other predictor variables, that seemed crucial for innovation performance as per the pertinent literature, are not statistically significant for present study. For instance, the top manager's years of experience in the sector not significant. Here, it is important to note that quantitative measures such as 'tenure' offer little insight into the value of experience since learning from experience is not automatic and "some people come away with nothing, the wrong lessons, or only some of what they might have learned". (McCall, 2004, Pg. 28; Gottschalk, 2007; Pg 58). This implies that simple count of years of experience of top manager may or may not be instrumental for innovation performance. From that perspective, "the most significant contingency in executive development is the nature of the challenges that leaders face in enacting the business strategy" (McCall, 2004; Pg. 129) that cannot be covered in present study due to data unavailability. In fact, it is one of the limitations for the current study.

Further, the managerial educational ratio is also not statistically significant. It implies that the business degree (i.e. M.B.A) is not very promising indicator for the innovation performance. It is long recognized that the education and skills of the labour force have implications for the firms' innovation performance. [12]Innovation is only possible if there are skilful employees "who can perform research that generates new ways of thinking and new knowledge, who can apply their knowledge and skills, who can adopt new technologies and processes, and who can adapt to change". Also, OECD (2011) identifies a wide range of skills needed for innovation, including technical skills, academic skills, generic skills (like problem solving), creativity, soft skills (like attitudes and behaviours), and management and entrepreneurial skills. Present study doesn't takes into account other skills or knowledge of employees that might be pertinent for innovation performance as well. [12]Conference board of Canada assess the relationship between advanced skills and innovation performance using three advanced-skills indicators from the Education report card. These are:

- university completion
- PhD graduates
- science and engineering graduates

This means that overall managers' management education, on its own, doesn't significantly impact the innovation performance in a firm. Apparently, it is the cumulative knowledge constituted by knowledge possessed by the technical personnel and managers together that seem to be effectual for firms' innovation performance.

The study takes into account the impact of upper and middle managers impact on the innovation performance of firms measured through management ratio. However, it should be noted here

[12] http://www.conferenceboard.ca/hcp/hot-topics/innovation.aspx

that the lower level managers and other technical personnel are equally important to the innovation process. This may be one of the reasons that the management ratio has no significant impact on the innovation performance.

Lastly, curvilinear term for female managers count is non-significant. Though the linear term for number of female managers is significant indicating that increasing the gender diversity will increase the innovation performance of firms, the analysis fails to confirm the curvilinear relation between the number of female managers and innovation performance. This may simply reflect the notion that the hypothesis is not held because there is no negative effect to continually adding more female managers. However, a more likely reason may be that there is simply not enough number of female managers in sample firms to reach the point after which the diversity adversely affects innovation output.

VI. FUTURE RESEARCH & LIMITATIONS

One of the limitation for the present study is with the predicted variable, innovation intensity. We have continuous data for the variable innovation intensity that ranges from 0 to 100 percent. Let's assume that a firm reported very high innovation intensity, which would signify high percentage of sales from new products. But, it is unclear whether the higher sales reported is due to large spectrum of new products/services introduced or from few ones. Also, we don't have sufficient data that can yield more detailed information related to new product/s and/or service/s introduced, that is, whether the sales come from new products/services that are new to the firm or new to the industry and according to Mohnen and Dagenais (2000) such a distinction is important to get a better and qualitative insight from variable describing innovation performance of firms.

Second limitation is that due to unavailability of data, the study doesn't taken into consideration moderating effects of any external contextual factors such as 'competitive intensity', 'environmental uncertainties' or internal factors such as 'degree of centralization' or 'hierarchy' on the managerial demographics-innovation performance relationship.

Lastly, the empirical analysis reports fewer predictor variables that are significant in case of each of the two models (see fig. 4 & 5) that can be attributed to the cross-sectional nature of the study that, apparently, lowers the power of study to detect causal relationship between the independent and dependent variables. Besides, the insignificance of other predictor variables can also be explained, in part, by the high significance of control variables taken into for the study (see table 10).

Table 10: SIGNIFICANT CONTROL VARIABLES

DEPENDENT VARIABLES	**INNOVATION INTENSITY**	**WHETHER PERFORMED INNOVATION? Y/N**
CONTROL VARIABLES	• SIZE • COUNTRY • R&D EXPENDITURES	• SIZE • COUNTRY • R&D EXPENDITURES

The limitations for the present research have future research implications. Also, the results of the current study are context-specific and should be viewed cautiously when extended to other contexts. Though, we are reluctant regarding the generalization of this study to other settings, it is theoretically appropriate to believe that firms in other contexts may report similar patterns of managerial role. This speculation needs to be validated by future research efforts to be undertaken in other contexts (Li, et al., 2008). Moreover, the cross-sectional data used in the study does not allow for causal interpretation among the factors. Ideally, the study would have benefited from a time lag between the measurement of the independent and dependent variables in order for causal relationships to be determined (Li, et al 2008).

Finally, inclusion of broader sets of variables and conducting a longitudinal study in other contexts would not only weave a more profound picture about the managerial role, but also improve the construct, internal and external validity of the study. Regardless of all the weaknesses and limitations, we hope that the present study, to some extent, has successfully addressed the reported gap in innovation literature on managerial role.

Heterogeneity of manufacturing sectors

Present study explores the innovation performance of firms in 9 different sectors (as shown in table 2) and it is imperative to discuss the role of heterogeneity of these sectors while evaluating the innovation performance.

Table 2: All the sectors in study

Food
Textiles
Garments
Chemicals
Plastics & rubber
Non metallic mineral products
Basic metals
Fabricated metal products
Machinery and equipment
Electronics (31 & 32)
Other manufacturing

Heterogeneity of 'manufacturing sectors' implies two things - Firstly, firms of various manufacturing sectors differ from each other. Secondly, firms within the same sector differ from each other.

This is intriguing, considering the prior research in evolutionary economics that has highlighted that firms within the same industry share "similar characteristics, knowledge bases, and tend to pursue the same kinds of innovation strategies due to technological regimes and sectoral innovation system approaches underlying industry evolution" (Clausen, 2008; pg.2). But, now it is widely accepted that firms not only across the industry but also within the industry differs in terms of performance and profitability. Now, the question arises whether there are common set of factors that create firm-heterogeneity both at industry as well as cross-industry levels. However, such a discussion is out of scope of current research.

For the present study, the main focus is on the factors that contribute to differences in innovation performance of firms. Moreover, the sources of heterogeneous performance at the firm level is less known and "evolutionary and resource-based theories argue that diversity in performance stems from differences in innovative capabilities across firms" (Teece, et al, 1997), but not much research has been done in the field (Clausen, 2008; Pg. 3).

The firms within the same industry or across industry differ in terms of innovation performance due to differing innovative capabilities and according to 'strategic management' literature, "profitability stems from resources, capabilities and actions that are unique to firms" (Clausen, 2008). However, resource-based theories argue that there are 'resources' specific to firms determine performance in terms of profitability. So, in light of the above theoretical contexts, sources of profitability are located at the firm level.

As discussed in the section 'Managerial Knowledge' on pg. 7, the organizational knowledge is cumulative sum of individuals' knowledge i.e. unique to every organization. From this point of view, organizations differ in cognitions and perspectives (Nelson and Winter, 1982). However, in the behaviour theory, organizations initiate search efforts for innovation in relation to managerial perceptions of problems and "innovation in this context is an outcome of learning processes where firms search for new routines in a limited rational way" (Clausen, 2008). Thus, cognitive abilities of management impact the decision of 'searching for innovation' and become an important source of firm heterogeneity. Moreover, if firms have different perceptions, they will initiate different organizational learning efforts and pursue heterogeneous search paths for new innovations (Dosi et al, 1997) that will result in different innovation performance.

Whilst one would anticipate different patterns of innovation across industrial sectors (and, given different industrial distributions, across countries), the inclusion of sectoral controls in the model allows us to examine the marginal effects of the different variables of interest “as if” sector was held constant. Undoubtedly, further analysis which explores patterns within sectors would be illuminating, but it is not clear that the current data is competent to meet this challenge.

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APPENDIX A-SURVEY & SURVEY QUESTIONNAIRE

SAMPLE FRAME AND STRATIFICATION USED IN MOI SURVEY

The Management, Organisation and Innovation (MOI) survey includes (according to ISIC, revision 3.1) all manufacturing sectors (group D). Since management and organization tend to come to the forefront in medium and large establishments, the sample frame for each country should include only establishments with at least fifty (50) but less than 5000 employees. If available and of sufficient quality in terms of representativeness of the manufacturing sector the preferred sample frame is Bureau van Dijk's Orbis database, which contains published balance sheet and income and loss statements. When this source is not available or is of poor quality, the official sample frames without financial performance information can be used. Including other dimensions of interest, such as location as variable of interest adds another dimension to the sampling strategy. If a second dimension is included, this is to ensure that choosing firms randomly from the stratified sample frame will resemble the distribution of the population. For example, if location is the second dimension, making sure that the sample frame is stratified by region will be enough to meet this require.

General instructions on sample frame and sample selection are:

i. Preferred sample frame is the Bureau van Dijk's Orbis database, when available and of acceptable quality in terms of being representative of the manufacturing sector. The MOI sample frame will be matched to the BEEPS sample frame (which comes from official sources, such as national statistical offices or national business registries) by EBRD and the World Bank, and the final decision on which sample frame to use will be made based on how closely the MOI sample frame resembles the BEEPS sample frame along the following dimensions: number of firms in the manufacturing sector of a defined size and regional distribution, where applicable. MOI sample frame is not available for Kazakhstan and Uzbekistan, so BEEPS sample frame will be used there.
ii. No stratification will be used in majority of the countries (see below for exceptions), but the sample needs to be selected randomly, it needs to cover all regions and at least a 25 per cent response rate is required to be achieved. The implementing local institutes should not be issued the entire sample frame, they should only be issued the selected sample and up to 2 substitutions, as is the case with BEEPS.
iii. Sample needs to be stratified at the level of regions in the case of Russia. In other countries the target share of interviews in each region is half of that region's share in the population. For example, if region ABC has 10% of the population of firms inside from country XYZ then at least 5% of the sample most be from this region. So if country XYZ has a target sample of 200 firms this means that 10 firms (5% of 200) need to be interviewed from region ABC.

Sample should be selected randomly from every cell, with probability depending on the size of the universe in each cell. The exception to this rule is panel firms, which are available in Germany and Poland.

APPENDIX B

Post-hoc analysis of the countries under-study and discussion of the heterogeneity of the manufacturing sectors-

To further explore the extent to which different patterns are observed in different countries, I re-estimated the regression equations individually for each country.

Table 2: Statistically significant variables in all 12 countries.

COUNRIES / IND. VARIABLES	BULAGRIA	BELARUS	GERMANY	INDIA	KAZAKH STAN	LITHUA NIA	POLAND	ROMANIA	RUSSIA	SERBIA	UKRAI NE
FEMALE MANAGERS	✓		✓	✓			✓		✓		✓
QUADRATIC_F EMALE TERM											✓
MANAGERIAL MNC EXP	✓		✓	✓	✓	✓			✓		
QUADRATIC MNC TERM					✓	✓					
MANAGEMENT RATIO									✓		
QUADRATIC MANAGEMENT RATIO				✓						✓	
TOP MANAGER'S EXPERIENCE					✓	✓					
EDUCATIONAL					✓						

RATIO											
FIRM-SIZE		✓				✓	✓	✓			
FIRM AGE											
SECTOR CLASSIFICATION	✓			✓							
R&D EXPENDITURES	✓	✓	✓	✓	✓			✓	✓	✓	✓

Above table indicate the statistical significance of all predicted variables in each country under study. According to Hultberg (1998), productivity growth is influenced by country heterogeneity which he explored as a cross-sectional estimation between average inefficiency levels and a set of institutional variables (such as political and civil rights, political stability, bureaucratic efficiency etc.). And they obtained a high correlation between the variables that confirms that heterogeneity stem from institutional differences. So, there are different set of internal and external factors that might impact the innovation performance of firms in different countries. The study further underlines that nations differ in technology adoption and differences in absorptive capacity may result in different innovation potential in different countries. Therefore, the institutional differences and differing technology-adoption practices shapes the firms' innovation potential that results in varying innovation performances. Therefore, the post-hoc analysis confirms that there are different set of variables that impact the innovation performances of firms in different countries.

APPENDIX C - SPSS OUTPUT

I. LOGISTIC REGRESSION OUTPUT-SPSS 17.0

LOGISTIC REGRESSION VARIABLES INNOVATIVENESS /METHOD=ENTER FIRM_AGE R_and_D_EXPENDITURE_1 SECTOR_CLASSIFICATION FIRM_SIZE COUNTRY_CODE FEMALE_MANAGERS CURVILINEAR_FEMALE_MANAG ERS NUMBER_MANAGERS_MNC_EXPERIENCE CENTERED_MANAGERS_MNC_EXPERIENCE MANAGEMENT_RATIO CENTERED_MANAGEMENT_RATIO EDUCATIO_RATIO TOP_MANAGERS_EXPERIENCE /CONTRAST (COUNTRY_CODE)=Indicator /CONTRAST (SECTOR_CLASSIFICATION)=Indicator /SAVE=COOK SRESID /CLASSPLOT /PRINT=GOODFIT CI(95) /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).

Notes

Output Created		06-Oct-2012 02:38:56
Comments		
Input	Data	C:\Users\Owner\Desktop\ALL_COUNTRIES_STATA.dta
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1777
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing

Syntax		LOGISTIC REGRESSION VARIABLES INNOVATIVENESS /METHOD=ENTER FIRM_AGE R_and_D_EXPENDITURE_1 SECTOR_CLASSIFICATION FIRM_SIZE COUNTRY_CODE FEMALE_MANAGERS CURVILINEAR_FEMALE_MANAGERS NUMBER_MANAGERS_MNC_EXPERIENCE CENTERED_MANAGERS_MNC_EXPERIENCE MANAGEMENT_RATIO CENTERED_MANAGEMENT_RATIO EDUCATIO_RATIO TOP_MANAGERS_EXPERIENCE /CONTRAST (COUNTRY_CODE)=Indicator /CONTRAST (SECTOR_CLASSIFICATION)=Indicator /SAVE=COOK SRESID /CLASSPLOT /PRINT=GOODFIT CI(95) /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).
Resources	Processor Time	0:00:00.078
	Elapsed Time	0:00:00.085
Variables Created or Modified	COO_3	Analog of Cook's influence statistics
	SRE_3	Standard residual

[DataSet1] C:\Users\Owner\Desktop\ALL_COUNTRIES_STATA.dta

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	1769	99.5
	Missing Cases	8	.5
	Total	1777	100.0
Unselected Cases		0	.0
Total		1777	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Categorical Variables Codings

		Frequency	Parameter coding (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
COUNTRY_CODE	0	100	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	1	154	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	2	221	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000
	3	200	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000
	4	125	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000
	5	99	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000
	6	102	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000
	7	150	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000
	8	214	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000
	9	134	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000
	10	147	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000
	11	123	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
SECTOR_CLASSIFICATION	0	985	1.000	.000	.000								
	1	425	.000	1.000	.000								
	2	278	.000	.000	1.000								
	3	81	.000	.000	.000								

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted: WHETHER_PERFORMED_INNOVATION 0	Predicted: WHETHER_PERFORMED_INNOVATION 1	Percentage Correct
Step 0	WHETHER_PERFORMED_INNOVATION	0	0	596	.0
		1	0	1173	100.0
	Overall Percentage				66.3

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.677	.050	181.174	1	.000	1.968

Variables not in the Equation[a]

			Score	df	Sig.
Step 0	Variables	FIRM_AGE	.043	1	.836
		R_and_D_EXPENDITURE_1	3.418	1	.064

SECTOR_CLASSIFICATION	13.337	3	.004
SECTOR_CLASSIFICATION(1)	9.315	1	.002
SECTOR_CLASSIFICATION(2)	.141	1	.707
SECTOR_CLASSIFICATION(3)	8.964	1	.003
FIRM_SIZE	18.294	1	.000
COUNTRY_CODE	145.085	11	.000
COUNTRY_CODE(1)	8.894	1	.003
COUNTRY_CODE(2)	2.645	1	.104
COUNTRY_CODE(3)	30.765	1	.000
COUNTRY_CODE(4)	64.652	1	.000
COUNTRY_CODE(5)	2.396	1	.122
COUNTRY_CODE(6)	17.941	1	.000
COUNTRY_CODE(7)	12.472	1	.000
COUNTRY_CODE(8)	5.910	1	.015
COUNTRY_CODE(9)	6.168	1	.013
COUNTRY_CODE(10)	1.698	1	.193
COUNTRY_CODE(11)	.007	1	.931
FEMALE_MANAGERS	11.647	1	.001
CURVILINEAR_FEMALE_MANAGERS	.152	1	.697

	NUMBER_MANAGERS_MNC_EXPERIENCE	7.275	1	.007
	CENTERED_MANAGERS_MNC_EXPERIENCE	1.542	1	.214
	MANAGEMENT_RATIO	2.171	1	.141
	CENTERED_MANAGEMENT_RATIO	.520	1	.471
	EDUCATIO_RATIO	.022	1	.881
	TOP_MANAGERS_EXPERIENCE	.179	1	.672

a. Residual Chi-Squares are not computed because of redundancies.

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	410.769	25	.000
	Block	410.769	25	.000
	Model	410.769	25	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1849.896[a]	.207	.287

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1849.896[a]	.207	.287

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7.702	8	.463

Contingency Table for Hosmer and Lemeshow Test

		WHETHER_PERFORMED_INNOVATION = 0		WHETHER_PERFORMED_INNOVATION = 1		
		Observed	Expected	Observed	Expected	Total
Step 1	1	130	127.511	47	49.489	177
	2	103	98.105	74	78.895	177
	3	91	91.225	86	85.775	177
	4	83	81.528	94	95.472	177
	5	70	67.360	107	109.640	177
	6	45	52.075	132	124.925	177
	7	24	32.647	153	144.353	177

8	21	23.124	156	153.876	177
9	18	14.884	159	162.116	177
10	11	7.542	165	168.458	176

Classification Table[a]

Observed			Predicted		
			WHETHER_PERFORMED_INNOVATION		Percentage Correct
			0	1	
Step 1	WHETHER_PERFORMED_INNOVATION	0	316	280	53.0
		1	193	980	83.5
	Overall Percentage				73.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	FIRM_AGE	.000	.000	.712	1	.399	1.000	1.000	1.000
	R_and_D_EXPENDITURE_1	.000	.000	162.690	1	.000	1.000	1.000	1.000
	SECTOR_CLASSIFICATION			1.434	3	.697			
	SECTOR_CLASSIFICATION(1)	-.064	.302	.045	1	.833	.938	.519	1.695

SECTOR_CLASSIFICATION(2)	-.183	.315	.338	1	.561	.833	.449	1.545
SECTOR_CLASSIFICATION(3)	.041	.330	.015	1	.902	1.042	.545	1.989
FIRM_SIZE	.000	.000	2.127	1	.145	1.000	1.000	1.001
COUNTRY_CODE			98.022	11	.000			
COUNTRY_CODE(1)	.486	.356	1.863	1	.172	1.626	.809	3.268
COUNTRY_CODE(2)	-.233	.277	.705	1	.401	.792	.460	1.365
COUNTRY_CODE(3)	.729	.293	6.185	1	.013	2.073	1.167	3.683
COUNTRY_CODE(4)	-1.296	.272	22.701	1	.000	.274	.161	.466
COUNTRY_CODE(5)	-.168	.293	.329	1	.566	.845	.476	1.501
COUNTRY_CODE(6)	1.304	.367	12.636	1	.000	3.683	1.795	7.558
COUNTRY_CODE(7)	.571	.355	2.586	1	.108	1.770	.883	3.549
COUNTRY_CODE(8)	-.150	.269	.311	1	.577	.861	.508	1.458
COUNTRY_CODE(9)	.215	.274	.616	1	.433	1.240	.724	2.124
COUNTRY_CODE(10)	-.136	.289	.222	1	.637	.873	.496	1.536
COUNTRY_CODE(11)	.014	.288	.002	1	.962	1.014	.576	1.784
FEMALE_MANAGERS	.019	.011	3.160	1	.075	1.019	.998	1.040
CURVILINEAR_FEMALE_MANAGERS	.000	.000	2.435	1	.119	1.000	1.000	1.000
NUMBER_MANAGERS_MNC_EXPERIENCE	.090	.026	11.433	1	.001	1.094	1.038	1.152
CENTERED_MANAGERS_MNC_EXPERIENCE	.000	.000	8.844	1	.003	.999	.999	1.000
MANAGEMENT_RATIO	-.004	.004	.909	1	.340	.996	.989	1.004

CENTERED_MANAGEMENT_RATIO	.000	.000	1.329	1	.249	1.000	1.000	1.000
EDUCATIO_RATIO	-.030	.061	.241	1	.624	.971	.861	1.094
TOP_MANAGERS_EXPERIENCE	.006	.006	.976	1	.323	1.006	.995	1.017
Constant	1.708	.412	17.173	1	.000	5.519		

a. Variable(s) entered on step 1: FIRM_AGE, R_and_D_EXPENDITURE_1, SECTOR_CLASSIFICATION, FIRM_SIZE, COUNTRY_CODE, FEMALE_MANAGERS, CURVILINEAR_FEMALE_MANAGERS, NUMBER_MANAGERS_MNC_EXPERIENCE, CENTERED_MANAGERS_MNC_EXPERIENCE, MANAGEMENT_RATIO, CENTERED_MANAGEMENT_RATIO, EDUCATIO_RATIO, TOP_MANAGERS_EXPERIENCE.

TOBIT REGRESSION: STATA 9.0

```
  /__    /   ____/   /   ____/
 ___/   /   /___/   /   /___/     9.0   Copyright 1984-2005
  Statistics/Data Analysis               StataCorp
                                         4905 Lakeway Drive
                                         College Station, Texa
> s 77845 USA
                                         800-STATA-PC        h
> ttp://www.stata.com
                                         979-696-4600        s
> tata@stata.com
                                         979-696-4601 (fax)

Single-user Stata for Windows perpetual license:
       Serial number:  199047098
         Licensed to:  asmita sharma
                       stata

Notes:
      1.  (/m# option or -set memory-) 1.00 MB allocated
> to data

. set memory 4m
(4096k)

. use "C:\Users\Owner\Desktop\ALL_COUNTRIES_FINAL_THESIS\ALL COUNTRIES ANLAYSIS\ALL_COUNTRIES_STATA.dta", clear
```

```
Tobit regression                                  Number of obs   =       1769
                                                  LR chi2(24)     =     273.27
                                                  Prob > chi2     =     0.0000
Log likelihood = -5953.5566                       Pseudo R2       =     0.0224
```

INNOVATION~Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
FIRM_AGE	-.0019564	.0018719	-1.05	0.296	-.0056278	.0017151
R_and_D_EX~1	-1.40e-08	1.24e-09	-11.29	0.000	-1.64e-08	-1.16e-08
NUMBER_MAN~E	.753069	.2491369	3.02	0.003	.2644307	1.241707
CENTERED_M~E	-.0080252	.0030565	-2.63	0.009	-.01402	-.0020304
FEMALE_MAN~S	.2034379	.1082462	1.88	0.060	-.008868	.4157438
TOP_MANAGE~E	.1049731	.0739562	1.42	0.156	-.0400791	.2500252
MANAGEMENT~O	-.0279664	.0333928	-0.84	0.402	-.0934604	.0375277
CENTERED_M~O	.0000567	.000068	0.83	0.404	-.0000766	.00019
FIRM_SIZE	.0043352	.0021627	2.00	0.045	.0000935	.0085769
EDUCATIO_R~O	.2139507	.7961862	0.27	0.788	-1.347629	1.77553
BELARUS	-.4263147	4.031229	-0.11	0.916	-8.332863	7.480234
BULGARIA	-4.646316	3.064034	-1.52	0.130	-10.65588	1.363248
INDIA	-24.21197	3.333127	-7.26	0.000	-30.74931	-17.67462
KAZAKHSTAN	-5.549675	3.619197	-1.53	0.125	-12.64809	1.548745
LITHUANIA	10.67823	3.746599	2.85	0.004	3.329934	18.02653
POLAND	-.5126317	3.803609	-0.13	0.893	-7.972743	6.947479
ROMANIA	-1.785467	3.335582	-0.54	0.593	-8.327626	4.756691
RUSSIA	-2.754728	3.058426	-0.90	0.368	-8.753293	3.243838
SERBIA	-7.465502	3.954359	-1.89	0.059	-15.22128	.2902789
UKRAINE	-3.532443	3.414002	-1.03	0.301	-10.22841	3.163522
LOW_TECH	2.574629	3.761505	0.68	0.494	-4.802902	9.952159
LO_MEDIUM_~H	2.09005	3.930161	0.53	0.595	-5.61827	9.798371
MEDIUM_HIG~H	2.52952	4.060076	0.62	0.533	-5.433606	10.49264
CURVILINEA~S	-.0010863	.000674	-1.61	0.107	-.0024084	.0002357
_cons	19.49316	4.550257	4.28	0.000	10.56863	28.41769
/sigma	30.2629	.686142			28.91715	31.60864

```
  Obs. summary:        605  left-censored observations at INNOVATION_INTENSITY<=0
                      1129     uncensored observations
                        35 right-censored observations at INNOVATION_INTENSITY>=100
```